Exercise 1.1 — The sample space

Q1 **a)** There is 1 outcome corresponding to the 7 of diamonds, and 52 outcomes in total.
So P(7 of diamonds) = $\frac{1}{52}$

b) There is 1 outcome corresponding to the queen of spades, and 52 outcomes in total.
So P(queen of spades) = $\frac{1}{52}$

c) There are 4 outcomes corresponding to a '9', and 52 outcomes in total. So P(9 of any suit) = $\frac{4}{52} = \frac{1}{13}$

d) There are 26 outcomes corresponding to a heart or a diamond, and 52 outcomes in total.
So P(heart or diamond) = $\frac{26}{52} = \frac{1}{2}$

Q2 **a)** 6 of the 36 outcomes are prime numbers.
So P(product is a prime number) = $\frac{6}{36} = \frac{1}{6}$

b) 14 of the 36 outcomes are less than 7.
So P(product is less than 7) = $\frac{14}{36} = \frac{7}{18}$

c) 6 of the 36 outcomes are multiples of 10.
So P(product is a multiple of 10) = $\frac{6}{36} = \frac{1}{6}$

Q3 **a)** E.g.

b) There are 5 ways of getting an even number and 'tails', and 20 outcomes altogether.
So P(even number and tails) = $\frac{5}{20} = \frac{1}{4}$

Q4 **a)** E.g.

–	1	2	3	4	5	6
1	0	1	2	3	4	5
2	1	0	1	2	3	4
3	2	1	0	1	2	3
4	3	2	1	0	1	2
5	4	3	2	1	0	1
6	5	4	3	2	1	0

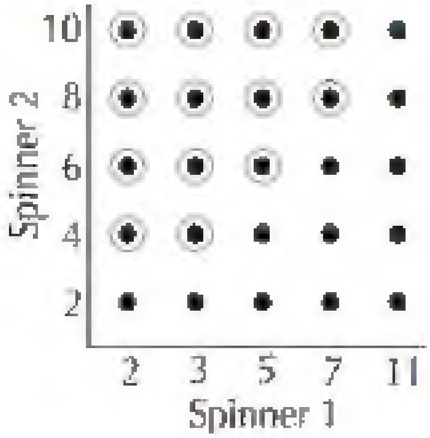
b) 6 of the 36 outcomes are zero.
So P(score is zero) = $\frac{6}{36} = \frac{1}{6}$

c) None of the outcomes are greater than 5.
So P(score is greater than 5) = 0

d) The most likely score is the one corresponding to the most outcomes — so it's 1.
10 of the 36 outcomes give a score of 1, so:
P(1) = $\frac{10}{36} = \frac{5}{18}$

Q5 Start by drawing a sample-space diagram to show all the possible outcomes for the two spins combined. Then circle the ones that correspond to the event 'number on spinner 2 is greater than number on spinner 1'.

E.g.

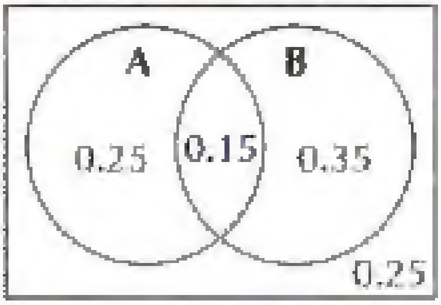


There are 13 outcomes that correspond to the event 'number on spinner 2 is greater than number on spinner 1', and 25 outcomes altogether.
So P(spinner 2 > spinner 1) = $\frac{13}{25}$

Exercise 2.1 — Venn diagrams and two-way tables

Q1 a) Label the diagram by starting in the middle with the probability for A and B. Then subtract this probability from P(A) and P(B). And remember to find P(neither A nor B) by subtracting the other probabilities from 1.

So:



b) P(neither A nor B) = 0.25

Q2 a) Use the totals to fill in the gaps:

No coffee/BC Tops = 0.51 – 0.16 – 0.11 = 0.24
'No coffee' total = 0.24 + 0.12 + 0.14 = 0.50
'Nenco' total = 1 – 0.18 – 0.50 = 0.32
Nenco/No tea = 0.32 – 0.16 – 0.07 = 0.09
'Cumbria' total = 1 – 0.51 – 0.27 = 0.22
Yescafé/No tea = 0.27 – 0.09 – 0.14 = 0.04
Yescafé/Cumbria = 0.22 – 0.07 – 0.12 = 0.03

	BC Tops	**Cumbria**	**No tea**	**Total**
Nenco	0.16	0.07	**0.09**	**0.32**
Yescafé	0.11	**0.03**	**0.04**	0.18
No coffee	**0.24**	0.12	0.14	**0.50**
Total	0.51	**0.22**	0.27	1

b) (i) P(Cumbria and Yescafé) = 0.03

(ii) P(Coffee) = 1 – P(No coffee) = 1 – 0.50 = 0.50

You could also find this by adding up the totals for the two brands of coffee: P(Coffee) = P(Nenco) + P(Yescafé) = 0.32 + 0.18 = 0.50

(iii) P(tea but no coffee) = P(BC Tops and no coffee) + P(Cumbria and no coffee) = 0.24 + 0.12 = 0.36

Another way to find this is P(No coffee) – P(No coffee and no tea) = 0.50 – 0.14 = 0.36

Q3 a) Let M be 'studies maths' and P be 'studies physics'. The total number of students is 144, so that goes in the bottom right-hand corner. You can also fill in the totals for the P row and the M column — these are the total number of students studying each subject. You also know the number that study both:

	M	not M	Total
P	19		38
not P			
Total	46		144

Now you can work out all the missing values:

	M	not M	Total
P	19	38 – 19 = **19**	38
not P	46 – 19 = **27**	98 – 19 = **79**	144 – 38 = **106**
Total	46	144 – 46 = **98**	144

b) M or P has 19 + 27 + 19 = 65 outcomes.
So P(M or P) = $\frac{65}{144}$

c) So you're only interested in the 46 students who study maths. 19 students study maths and physics, so P(maths student also studies physics) = $\frac{19}{46}$.

Q4 a) P(L and M) = 0.1

b) P(L and N) = 0

c) P(N and not L) = 0.25
Since N doesn't overlap with L, N and not L is just N.

d) P(neither L nor M nor N)
= 1 – (0.25 + 0.1 + 0.15 + 0.25) = 0.25

e) P(L or M) = 0.25 + 0.1 + 0.15 = 0.5

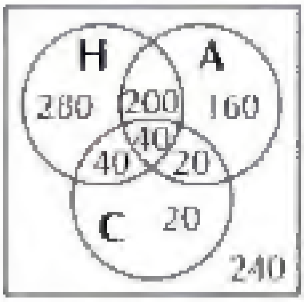
f) P(not M) = 0.25 + 0.25 + 0.25 = 0.75
Don't forget to include P(neither L nor M nor N).
You could also find P(not M) by doing 1 – P(M)
= 1 – (0.1 + 0.15).

Q5 **a)** Number of outcomes not in S or F or G
$= 200 - (17 + 18 + 49 + 28 + 11 + 34 + 6) = 37$
So P(not in S or F or G) $= \frac{37}{200}$

b) You're only interested in those people who have been to France — $49 + 28 + 34 + 11 = 122$ people.
The number of people who have been to France **and** Germany $= 28 + 34 = 62$.
So P(G, given F) $= \frac{62}{122} = \frac{31}{61}$

c) Number of outcomes in S and not F $= 17 + 18 = 35$.
So P(S and not F) $= \frac{35}{200} = \frac{7}{40}$

Q6 **a)** Start by drawing a Venn diagram to represent the information. If H = 'goes to home league matches', A = 'goes to away league matches' and C = 'goes to cup matches', then:



The people who go to exactly 2 types of match are those in (H and A and not C), (H and C and not A), and (A and C and not H).
That's $200 + 40 + 20 = 260$ people.
So P(2 types of match) $= \frac{260}{1000} = \frac{13}{50}$

b) P(at least 1 type of match) = 1 – P(no matches)
$= 1 - \frac{240}{1000} = \frac{760}{1000} = \frac{19}{25}$